CLAIMS

What is claimed is:

1. A method for de-embedding a device under test, the method comprising:

representing electrical characteristics of a test structure including a device under test using a set of test structure ABCD parameters;

representing electrical characteristics of a thru test structure using a set of thru S parameters;

partitioning the set of thru S parameters into a first set of partitioned S parameters and a second set of partitioned S parameters;

converting the first set of partitioned S parameters into a first set of partitioned ABCD parameters;

converting the second set of partitioned S parameters into a second set of partitioned ABCD parameters; and

using the first set of partitioned ABCD parameters, the second set of partitioned ABCD parameters, and the set of test structure ABCD parameters to produce a set of device ABCD parameters representative of intrinsic electrical characteristics of the device under test.

2. The method of claim 1 wherein representing electrical characteristics of a thru test structure using a set of thru S parameters further includes measuring electrical characteristics of the thru test structure to provide the set of thru S parameters.

3. The method of claim 1 wherein the representing electrical characteristics of a test structure including a device under test using a set of test structure ABCD parameters further comprises:

measuring electrical characteristics of the test structure to provide a set of S parameters; and

converting the set of S parameters into the set of test structure ABCD parameters.

4. The method of claim 1 wherein the first set of partitioned S parameters is characterized as a set of input S parameters and the second set of partitioned S parameters is characterized as a set of output S parameters.

5. The method of claim 4 wherein the set of input S parameters represent electrical characteristics of a two-port input network and the set of output S parameters represent electrical characteristics of a two-port output network.

6. The method of claim 4 wherein the set of thru S parameters are recoverable by cascading the set of input S parameters and the set of output S parameters.

7. The method of claim 4 wherein the using comprises:
cascading an inverse matrix of the first set of partitioned ABCD parameters with a matrix of the set of test structure ABCD parameters to produce an intermediate matrix; and
cascading the intermediate matrix with an inverse matrix of the second set of partitioned ABCD parameters to produce a matrix of the set of device ABCD parameters.

8. The method of claim 7 wherein the cascading comprises performing a matrix multiplication.

9. The method of claim 5 wherein the set of thru S parameters comprise:
a thru input reflection coefficient S_{11}THRU,
a thru output reflection coefficient S_{22}THRU,
a thru forward transmission coefficient S_{21}THRU; and
a thru reverse transmission coefficient S_{12}THRU.

10. The method of claim 9 wherein the partitioning comprises:
defining an input reflection coefficient S_{11}IN of the set of input S parameters to be equal to the thru input reflection coefficient S_{11}THRU;
defining an output reflection coefficient S_{22}OUT of the set of output S parameters to be equal to the thru output reflection coefficient S_{22}THRU; and
defining an output reflection coefficient S_{22}IN of the set of input S parameters to be equal to an input reflection coefficient S_{11}OUT of the set of output S parameters.

11. The method of claim 9 wherein the partitioning further comprises:

defining a magnitude of a forward transmission coefficient S_{21}IN of the set of input S parameters to be equal to a magnitude of a forward transmission coefficient S_{21}OUT of the set of output S parameters; and

defining a magnitude of a reverse transmission coefficient S_{12}IN of the set of input S parameters to be equal to a magnitude of a set reverse transmission coefficient S_{12}OUT of the set of output S parameters.

12. The method of claim 11 further comprising:

defining the magnitude of the forward transmission coefficient S_{21}IN and the magnitude of the forward transmission coefficient S_{21}OUT to be equal to an Xth root of the magnitude of the thru forward transmission coefficient S_{21}THRU; and

defining the magnitude of the reverse transmission coefficient S_{12}IN and the magnitude of the reverse transmission coefficient S_{12}OUT to be equal to an Xth root of the magnitude of the thru reverse transmission coefficient S_{12}THRU.

13. The method of claim 12 wherein X corresponds to a ratio of geometric distances measurable between an input node to the device under test of the test structure and the input node to an output node of the test structure.

14. The method of claim 12 wherein X is substantially equal to 2 when the device under test is substantially at a midpoint between the input node and the output node of the test structure.

15. The method of claim 9 wherein the partitioning comprises:

defining an angle of a forward transmission coefficient S_{21}IN of the set of input S parameters to be equal to an angle of a forward transmission coefficient S_{21}OUT of the set of output S parameters; and

defining an angle of a reverse transmission coefficient S_{12}IN of the set of input S parameters to be equal to an angle of a reverse transmission coefficient S_{12}OUT of the set of output S parameters.

16. The method of claim 9 wherein a forward transmission coefficient $S_{21}IN$ of the set of input S parameters, a forward transmission coefficient $S_{21}OUT$ of the set of output S parameters, and the thru forward transmission coefficient $S_{21}THRU$ are determined to have the following relationship:

$$\angle S_{21}IN = \angle S_{21}OUT = (\angle S_{21}THRU) / X.$$

17. The method of claim 16 wherein X corresponds to a ratio of geometric distances measurable between an input node to the device under test of the test structure and the input node to an output node of the test structure.

18. The method of claim 9 wherein a reverse transmission coefficient $S_{12}IN$ of the set of input S parameters, a reverse transmission coefficient $S_{12}OUT$ of the set of output S parameters, and the thru reverse transmission coefficient $S_{12}THRU$ are determined to have the following relationship: $\angle S_{12}IN = \angle S_{12}OUT = (\angle S_{12}THRU) / X$.

19. The method of claim 9 further comprising:
defining an output reflection coefficient $S_{22}IN$ of the set of input S parameters and an input reflection coefficient $S_{11}OUT$ of the set of output S parameters to be equal to $0 + j0$.

20. The method of claim 1 further comprising:
providing a de-embedded representation of the electrical characteristics of the device with substantially no parasitic characteristic information in such representation; and
incorporating the de-embedded representation of the electrical characteristics of the device into a circuit design library.

21. The method of claim 20 further comprising:
designing a circuit using the circuit design library.

22. The method of claim 21 further comprising:
fabricating an integrated circuit including the designed circuit.

23. An apparatus comprising:

means for de-embedding a transmission configurable device from an device test structure including the device and parasitic characteristics related to the device test structure using measured electrical characteristics of the device test structure and a thru test structure without requiring the use of measured electrical characteristics of a short test structure and an open test structure.

24. The apparatus of claim 23 further comprising:

means for representing electrical characteristics of the thru test structure as a plurality of matrices of thru ABCD parameters;

means for representing electrical characteristics of the device test structure using a matrix of ABCD parameters; and

means for producing a matrix of device ABCD parameters from the matrix of ABCD parameters and the plurality of inverse matrices of thru ABCD parameters.

25. The apparatus of claim 24 wherein the means for representing electrical characteristics of the thru test structure as a plurality of matrices of thru ABCD parameters comprises:

means for representing electrical characteristics of a thru test structure using a set of measured thru S parameters;

means for partitioning the set of measured thru S parameters into two sets of partioned S parameters; and

means for converting each of the two sets of partitioned S parameters into a set of partioned ABCD parameters.

26. The apparatus of claim 25 wherein a first set of the two sets is a set of input S parameters and a second set of the two sets is a set of output S parameters.

27. The apparatus of claim 26 wherein the means for partitioning the set of measured thru S parameters into two sets of partioned S parameters comprises:

means for setting an input reflection coefficient of the set of input S parameters to be equal to a thru input reflection coefficient of the set of measured thru S parameters; and

means for setting an output reflection coefficient of the set of output S parameters to be equal to a thru output reflection coefficient of the set of measured thru S parameters; and

means for setting an output reflection coefficient of the set of input S parameters to be equal to an input reflection coefficient of the set of output S parameters.

28. The apparatus of claim 26 wherein the means for partitioning the set of measured thru S parameters into two sets of partioned S parameters comprises:

means for assigning a relationship between forward transmission coefficients of the set of input S parameters and the set of output S parameters such that a magnitude of a forward transmission coefficient of the set of input S parameters is equal to a magnitude of a forward transmission coefficient of the set of output S parameters; and

means for assigning a relationship between reverse transmission coefficients of the set of input S parameters and the set of output S parameters such that a magnitude of a reverse transmission coefficient of the set of input S parameters is equal to a magnitude of a reverse transmission coefficient of the set of output S parameters.

29. The apparatus of claim 26 wherein the means for partitioning the set of measured thru S parameters into two sets of partioned S parameters comprises:

means for defining an angle of a forward transmission coefficient of the set of input S parameters to be equal to an angle of a forward transmission coefficient of the set of output S parameters; and

means for defining an angle of a reverse transmission coefficient of the set of input S parameters to be equal to an angle of a reverse transmission coefficient of the set of output S parameters.

30. The apparatus of claim 24 wherein the means for producing comprises:

means for cascading a first inverse matrix of a plurality of inverse matrices with the matrix of ABCD parameters to produce an intermediate matrix; and

means for cascading the intermediate matrix with a second inverse matrix of the plurality of inverse matrices to produce the matrix of device ABCD parameters.

31. The apparatus of claim 23 further comprising:
means for measuring electrical characteristics of the device test structure to provide a set of device S parameters.

32. The apparatus of claim 23 further comprising:
means for providing a de-embedded representation of the electrical characteristics of the device with substantially no parasitic characteristic information in such representation.

33. A computer program product encoded upon at least one computer readable media, the computer program product for de-embedding a transmission configurable device from a device test structure, the computer program product comprising:
code which, upon execution, is operational to represent electrical characteristics of a thru test structure as a plurality of sets of thru ABCD parameters;
code which, upon execution, is operational to represent electrical characteristics of the device test structure including a transmission configurable device using a set of ABCD parameters; and
code which, upon execution, is operational to produce a set of device ABDC parameters representative of intrinsic electrical characteristics of the device using the set of ABCD parameters and using the plurality of sets.

34. The computer program product of claim 33 wherein the code which, upon execution, is operational to represent electrical characteristics of a thru test structure as a plurality of sets of thru ABCD parameters further comprises:
code which, upon execution, is operational to represent electrical characteristics of a thru test structure using a set of measured thru S parameters;
code which, upon execution, is operational to partition the set of measured thru S parameters into a set of input S parameters and a set of output S parameters; and
code which, upon execution, is operational to convert the set of input S parameters into a set of input thru ABCD parameters and to convert the set of output S parameters into a set of output thru ABCD parameters.

35. The computer program product of claim 34 wherein code which, upon execution, is operational to partition the set of measured thru S parameters into a set of input S parameters and a set of output S parameters comprises:

code which, upon execution, is operational to set an input reflection coefficient of the set of input S parameters to be equal to a thru input reflection coefficient;

code which, upon execution, is operational to set an output reflection coefficient of the set of output S parameters to be equal to a thru output reflection coefficient of the set of measured thru S parameters; and

code which, upon execution, is operational to set an output reflection coefficient of the set of input S parameters to be equal to an input reflection coefficient of the set of output S parameters.

36. The computer program product of claim 34 wherein code which, upon execution, is operational to partition the set of measured thru S parameters into a set of input S parameters and a set of output S parameters comprises:

code which, upon execution, is operational to set an angle of a forward transmission coefficient of the set of input S parameters to be equal to an angle of a forward transmission coefficient of the set of output S parameters; and

code which, upon execution, is operational to set an angle of a reverse transmission coefficient of the set of input S parameters to be equal to an angle of a reverse transmission coefficient of the set of output S parameters.

37. The computer program product of claim 33 wherein the code which, upon execution, is operational to produce a set of device ABDC parameters comprises:

code which, upon execution, is operational to cascade an inverse matrix of a first set of the plurality of sets of thru ABCD parameters with a matrix of the set of ABCD parameters to produce an intermediate matrix; and

code which, upon execution, is operational to cascade the intermediate matrix with an inverse matrix of a set of the plurality of sets of thru ABCD parameters to produce a matrix of the set of device ABDC parameters.